Evaluation of an Explicit Approach to Teach Grammatical Forms to Children with Developmental Language Disorders

A Thesis
SUBMITTED TO THE FACULTY OF
UNIVERSITY OF MINNESOTA
BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF ARTS

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May 2017

Abstract

Purpose: Current grammatical intervention approaches are inadequate. The most rigorous treatment studies report modest gains after many treatment session over an extended period of time. Moreover, there is a paucity of studies that evalute the effectiveness of grammar intervention for populations other than SLI. The current study evaluated an alternative, explicit instruction procedure to teach true grammatical forms to children with developmental language disorders other than SLI**.**

Method: Researchers used a single-subject, multiple baseline, A-B-C study design. Two children, with characteristics of ASD (one with a formal diagnosis) between the ages of 5 and 6 years participated in treatment targeting a weak grammatical structure. Each participant completed a series of treatment sessions that comprised implicit instructional approaches followed a series of treatment sessions that incorporated an explicit instructional approach. Accuracy was assessed during each session across baseline, implicit, and explicit conditions as well as 1 week, 1 month, and 2 months post treatment.

Results: Results revealed a significant advantage for the explicit treatment over the implicit treatment. Immediately after introducing an explicit instructional approach a marked increase in level and upward trend was observed as well as an increase in percent of non-overlapping data compared to baseline and implicit phases for both participants. Gains in accuracy were maintained 2 months post treatment for Participant 1.

Conclusions: The current study provides preliminary evidence to support the use of explicit approaches to teach grammatical forms to children with language impairments, specifically ASD, and motivates further investigation in this area.

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Introduction

Grammatical deficits are often present in children with developmental language disorders, such as specific language impairment (SLI), Down syndrome, fragile X syndrome, and a subset of children with autism spectrum disorder (ASD; Kjelgaard & Tager- Flusberg, 2001; Rice, Warren, Betz, 2005; Rice & Warren, 2004). In fact, grammatical weaknesses have been identified as a core feature of children with SLI and proposed to be a clinical marker for diagnosis (Tager-Flusberg & Cooper, 1999; Leonard, Miller, & Gerber, 1999; Rice & Wexler, 1996; Rice, Wexler, Hershberger, 1998; Rice, Wexler, & Cleave, 1995). Studies have shown that children with SLI will continue to omit grammatical morphemes such as verb tense and agreement markers (e.g., past tense -ed and third person singular -s) in obligatory contexts for much longer than age-matched peers as evidenced by natural language sampling (Bedore & Leonard, 1998; Leonard, Miller, Gerber, 1999; Rice et al., 1998) and elicitation tasks (Rice et al., 1995).

Researchers have also found similar patterns of grammatical weaknesses in other populations. For example, Eadie, Fey, Douglas, & Parsons (2002) found similarities in grammatical deficits between children with SLI and Down syndrome in use of tense (e.g., third person singular -s) and non-tense morphology (e.g., omission of articles and -ing). In this study, children with Down syndrome showed significantly lower performance on past tense marking (-ed) and present progressive marking (-ing) in comparison to typically developing children matched on mean length utterance (MLU). Several studies have also reported deficits in grammatical development in children with fragile X syndrome (FXS) beyond what would be expected based on mental age, which suggests an

impairment similar to SLI (Estigarribia, Roberts, Siderisis, & Price, 2011; Finestack & Abbeduto, 2010, Sterling, Rice, & Warren, 2012). Additionally, there is evidence that although language skills vary widely in children with ASD, there is a subgroup of children with ASD who exhibit impaired production of grammatical morphemes and complex sentences similar to children with SLI (Eigsti, Bennetto, & Dadlan, 2007; Kjelgaard & Tager-Flusberg, 2001; Roberts, Rice & Tager-Flusberg, 2004; Rapin & Dunn, 2003).

Despite a broad range of affected populations, there are relatively few studies that have examined grammatical interventions for children, and those that do exist have primarily focused on children with SLI. Moreover, existing studies suggest that traditional grammatical intervention approaches yield only moderate outcomes. Traditional grammatical interventions primarily rely on use of implicit approaches or grammar facilitation techniques such as modeling, focused stimulation, recasting, and imitation. These techniques aim to increase the frequency children encounter target forms and provide children opportunities to practice target forms they typically omit. However, the most rigorous treatment studies relying exclusively on these implicit approaches indicate that children require many treatment sessions to achieve modest gains (e.g., Fey et. al 1993; Gilbert, 1994; Leonard, Camarata, Brown, & Camarata, 2004; Leonard, Camarata, Brown, & Camarata, 2006).

An alternative approach to grammatical intervention that may be more efficacious is one that uses explicit instruction. Explicit or metalinguistic approaches are based on the perspective that children with language impairments have difficulty learning grammar

implicitly and benefit from explicit teaching of the grammar rules (Ebbels et al., 2014). With explicit instruction, the child is given explicit, direct instruction of the rules guiding the use of difficult morphosyntactic structures (e.g., teaching a child that when we talk about something that happened in the past, a /t/ or /d/ sound comes at the end of the verb). The number of studies evaluating the efficacy of explicit approaches is much less in comparison to implicit approaches, but there is preliminary evidence to suggest that explicit approaches are effective for school-age children with language impairment (Bolderson et al., 2011; Kulkarni et al., 2014; Finestack & Fey 2009; Smith-Lock et al, 2013). Thus, the current study aims to examine the effectiveness of incorporating an explicit instructional approach with traditional implicit approaches to teach grammatical forms to early school-age children with developmental disabilities other than SLI.

Traditional Implicit Grammatical Intervention Approaches

Efficacy of implicit instructional approaches has been most widely investigated for children with SLI. Although implicit instructional approaches are often utilized in grammatical intervention, the most rigorous treatment studies indicate only modest outcomes (i.e., children often do not reach mastery) after many treatment sessions spanning a long period of time (Law, Garret, & Nye, 2004; Leonard et al., 2004; Leonard, Camarata, Pawloska, Brown & Camarata, 2006, 2008). Results of a meta-analysis reported by Law et al. (2004) suggest that traditional grammar intervention for children is inadequate. The analysis included thirteen speech-language interventions for preschool to school age children with SLI. Investigators reported mixed evidence to support the effectiveness of expressive grammar interventions, especially if children with

severe receptive language deficits were included. Studies included in the meta-analysis (e.g., Fey et. al 1993 & Gibbard, 1994) typically employed implicit instructional procedures such as focused stimulation, modeling, and recasting carried out by a clinician or a parent. Researchers found no significant effect for language intervention compared to no therapy when effect size was measured by assessments of overall syntactic ability, mean length utterances, total number of utterances, and parental report of phrase complexity.

Further evidence to support the need for more efficacious grammar intervention comes from Leonard and colleagues (Leonard, Camarata, Brown, & Camarata, 2004; Leonard, Camarata, Brown, & Camarata, 2006). Leonard et al. (2004) provided grammatical intervention to 31 children with SLI aged 3-4 years. Treatment comprised implicit instructional approaches such as focused stimulation (concentrated exposure to target embedded in a story) and conversational recasting (12 recasts per session) to target third person singular –s or auxiliary verbs is/are/was. After a total of 48 interventions sessions over 12 weeks (4 sessions per week) and 1,152 exposures to the grammatical target, researchers reported significantly greater gains on target forms in comparison to unrelated target forms. However, mean accuracy for both target forms remained below 50%. The mean accuracy for children whose target was third person singular was approximately 35% (highest percentage for any child was 82%), and the mean accuracy for children in the auxiliary group was approximately 24% (highest percentage for any child was 65%). Leonard et al. (2006) extended the treatment study by 48 sessions to total 96 sessions over a 6-month period. Again, although children made significant

progress in comparison to unrelated non-treated forms, few children reached mastery level with the mean accuracy at 53% for the third person singular group and 49% for the auxiliary group.

Plante et al. (2014) also reported moderately significant outcomes following treatment using implicit instructional approaches, specifically recasting. In this study, 18 children with SLI aged 4 to 5 years were randomly assigned to one of two conversational recast treatment conditions: high verb variability or low verb variability to improve use of various grammatical morphemes. Participants received 20-25, 30-minute sessions over a 6-week period. Researchers found that the children in the high verb variability group demonstrated significantly stronger performance on probes that tested generalization of the morpheme to new verbs. However, it is important to note that few children exceeded 50% production accuracy on the probes in either condition. In fact, the children in the low variability group made no significant gains from pretreatment to post treatment.

Overall, studies evaluating the effectiveness of grammatical interventions relying exclusively on implicit instruction report equivocal findings and are especially sparse for children of populations other than SLI. Despite evidence that grammatical deficits are present across a broad range of developmental disorders, there is little empirical evidence to support the use of implicit approaches for teaching grammatical forms to children with diagnoses other than SLI. Thus, there remains a need to develop more efficient and effective grammatical intervention that can be applied to various populations.

Explicit Approaches Used In Grammatical Intervention

Explicit teaching approaches may provide an alternative to traditional approaches. In contrast to implicit approaches, explicit instructional approaches aim to make the child conscious of the target and the underlying pattern or rule that guides the language structure. This is done by directly teaching the child the context in which a target structure is obligatory. For example, explaining that when we talk about what someone or something does all the time, we put a /s/ at the end of the verb (e.g., "He run**s**."). Studies that utilize use of explicit approaches for grammar intervention typically do so in combination with traditional implicit approaches such as modeling, recasting, imitation, and focused stimulation (Bolderson et al., 2011, Kulkarni et al., 2014, Smith-Lock et. al, 2013).

One type of explicit instruction that investigators have examined use of with children with SLI involves visual cues. Bolderson et al. (2011) used a technique called "Colorful Semantics" in which unique colors and "question words" were used to indicate the argument roles of words in sentences. For example, verbs were coded yellow and the corresponding question word was "What doing?" and an agent was coded orange with "Who?" as the corresponding question.

Using a within-participant design study, Bolderson et al. (2011) provided treatment to six 5- and 6-year olds who received speech-language services for expressive language difficulties such as lack of verb use, word order problems, failure to complete sentences, and omission of grammatical elements. Children received 12 to16, 30 to 45-minute treatment sessions over an 8-week period. Therapists modeled the target sentence

along with helping children construct a sentence using a color-coded board and asking them to say the sentence using the board to help them. The therapist explicitly reinforced the sentence by pointing to each color, saying what type of word it was, and by asking question words when necessary. The therapist also provided a recast to correct grammar (e.g., Child: "The boy walking." Therapist: "Yes, the boy i*s* walking."). Significant improvement was achieved on outcome measures during treatment conditions. This included significant improvement on grammar scores based on the Renfrew Action Picture Test (pre-therapy mean = 10.83 and post-therapy mean = 15.25) and increased mean sentence length scores (pre-therapy mean = 5.17 and post-therapy mean = 6.60).

Another visual explicit approach that has been examined is Shape Coding (Kulkarni et. al 2014). Similar to Colorful Semantics, Shape Coding uses a variety of shapes, colors, and arrows to indicate parts of speech and morphology. In a single-case study, Kulkarni et al. (2014) provided treatment to two children aged 8 and 9 years. Participant A had a diagnosis of SLI and Participant B had a diagnosis of ASD with language as his main area of need. Treatment targeted verb tense. Therapists engaged in explicit discussion of grammatical rules in addition to visually representing target structures using color, shapes, and arrows. (e.g., verbs underlined in blue; verb tense highlighted using placement of a down arrow). After 10, 30-minute therapy sessions, both children demonstrated significant improvement on the Regular Past Tense subtest of the Test of Early Grammatical Impairment (TEGI; Rice & Wexler, 2001). Participant A improved from 0% accuracy (0/20) to 100% accuracy (20/20) and Participant B improved from 15% accuracy (3/20) to 45% accuracy (9/20). However, gains did not generalize to

a semi-structured conversation task for Participant A until after additional generalization therapy was provided (pre-generalization therapy = 1/20 and post-generalization therapy = 11/20).

Smith-Lock et al. (2013) showed a significant effect of direct explicit teaching combined with grammar facilitation techniques for 5-year-old children with SLI. Treatment targets included increasing production of subject pronouns, possessive –s, or past tense *–ed*. The 34 study participants were assigned to one of two intervention groups: grammatical treatment program (experimental group) or the general classroom program (control group). Two grammatical targets were identified for each child in the treatment group, one to be treated and one untreated.

Groups met weekly for 1 hour over an 8-week period. The general classroom program focused on following directions and provided comprehension assistance. The grammatical treatment program provided repeated modeling of grammatical targets followed by opportunities for children to produce targets, receive feedback, and have opportunities to correct him/herself during play-based activities (e.g., playing with Play-Doh). In addition to focused stimulation, recasting, and imitations techniques, children in the treatment group received direct teaching of a grammatical target (e.g., "when we talk about boys, we say "he" and we talk about girls we say "she."). It is unclear how often children were provided the explicit rule guiding the grammar target during the play activity and on erroneous attempts at the target.

There was a significant difference (d = 1.24) in grammatical performance on pre- and post-treatment outcomes measures for children in the treatment group, but not for the

control group. Individual analyses showed that treatment was effective for majority of children. Furthermore, children in the experimental group, showed significantly more progress on treated targets (increased from 22% to 45%) than untreated targets (increased from 28% to 29%) over the intervention period. However, researchers recognized that grammar targets did not reach mastery levels.

Overall, although there is limited research is available on the efficacy of using explicit approaches to teach grammatical forms to children, especially those with diagnoses other than SLI, studies that do exist generally report positive outcomes and support further investigation.

Comparison of Explicit and Implicit Approaches

A few studies have compared the effectiveness of traditional implicit approaches and explicit approaches in improving expressive grammar (Finestack & Fey, 2009; Motsch & Riehemann, 2008). There is some preliminary evidence to suggest a significant advantage of explicit approaches over implicit approaches in children with SLI.

Motsch and Riehemann (2008) compared explicit and implicit instructional approaches in an intervention study that targeted dative and accusative case inflections. Participants included 126 German children aged 8-10 years. All children attended special schools for children with language impairments and a majority of children included in the study were identified as having SLI. Children in the control group were assigned to classrooms in which teachers used traditional modeling, while children in the experimental group were assigned to classrooms in which teachers used "Context-Optimization" (CO) techniques.

The CO condition combined implicit approaches with metalinguistic approaches to make the target structure and it's underlying grammatical rule explicitly known to the child. Researchers reported use of reading, writing, and visual capacities to support this metalinguistic awareness. Children in the experimental group received intervention for an average of 17 minutes 4 times a week over a period of 6 weeks for accusative case, 4 weeks for dative case, plus 2 weeks during which the two forms were contrasted. It is unclear how often children in the control group received intervention for each case marking, although the authors report that the children in the control group received specific training on each case marking at the same time as the experimental group.

Results from this study indicate that children learned the dative case better with the incorporation of explicit metalinguistic instruction than implicit intervention alone (post treatment mean accuracy: explicit = 36%; implicit = 21%). However, both methods were equally effective in teaching the accusative form. Researchers recognized that only three participants reached accuracy of over 80% for the dative case in this relatively short intervention (12 hours) and questioned if the CO therapy could be effectively implemented in a classroom setting versus individual therapy.

Finestack & Fey (2009) demonstrated that an explicit teaching procedure used in addition to modeling was more advantageous than an implicit procedure alone when teaching novel grammatical inflections to children with primary language impairment aged 6 to 8 years. Thirty-two participants were randomly assigned to an explicit teaching condition or traditional implicit teaching condition. The teaching target in both conditions was a novel grammatical morpheme that marked a verb in the sentence to specify the

gender of the subject. Instructors introduced the participants to "Tiki," a creature from outer space, who "uses a lot of the same words we do, but talks a little bit differently." The participants were then instructed to try to figure out Tiki's language so that they could talk just like her. Participants in the explicit teaching condition received direct instruction regarding the grammatical rule of Tiki's language ("If it is a boy, you have to add –pa to the end. If it is a girl, you have to add –po to the end"), while participants in the implicit teaching condition received nonspecific instruction ("Listen closely so you can talk like Tiki").

To assess learning, participants viewed stylized pictures of characters engaging in common actions and completed sentences describing the picture using the novel language being taught ("space creature's language"). Researchers reported that significantly more children in the explicit instruction condition met criteria to be considered a "pattern-user" (accuracy scores at or greater than 80%) by the fourth day of instruction. In addition, more children in the explicit condition generalized the inflection to untrained stimuli and were able to recall and apply previously taught inflections (maintenance of at least one day). Although these results show an advantage of explicit instruction to teach novel grammatical markers, researchers cannot conclude that the same outcomes would be observed when teaching true grammatical markers.

In sum, findings from available literature support further development of effective and efficient grammatical interventions for children with SLI as well as other populations of children with grammatical weaknesses. To date, studies have primarily focused on children identified with SLI and have evaluated traditional implicit instructional

approaches. Reported gains associated with implicit instructional approaches are often modest even after an extensive amount of treatment sessions. Preliminary evidence suggests that an alternative, explicit instructional approach may be more advantageous than traditional implicit approaches when teaching children with grammatical deficits. Thus, in the current study, we examined the use of a combined explicit and implicit approach to teach grammatical forms to children with ASD.

Current Study

The current study aimed to evaluate the efficacy of teaching English grammatical forms to children with developmental language disorders using an explicit intervention approach in combination with traditional recasting and focused stimulation intervention approaches. Using a single-subject, multiple baseline, nonconcurrent study design, the effects of an exclusively implicit intervention and an integrated explicit and implicit intervention were evaluated. For each participant, investigators identified a weak morphosyntactic structure and provided implicit instruction for a series of treatment sessions, followed by the addition of explicit instruction for series of treatment sessions. Accuracy in producing the target structure was measured throughout each condition to determine if the addition of explicit instruction significantly improved accurate production of the target. We anticipated that the explicit intervention would result in greater accuracy and a faster rate of acquisition compared to the implicit intervention. The specific study questions were:

1. Do children produce a grammatical target with greater accuracy and demonstrate a faster rate of acquisition when taught with a combined explicit and implicit approach than an implicit approach alone?

2. Do children demonstrate maintenance of accuracy when provided a combination of explicit and implicit instruction?

The current study extended the work of Finestack et al. (2009) in that it compared effectiveness of implicit instruction and explicit instruction and investigated whether the same outcomes could be achieved when teaching true grammatical forms (versus novel markings). The only other known study to date that compared the efficacy of these two approaches is the Motsch et al. (2008) study, which presented with certain limitations. As previously described, in the Motsch et al. study it was unclear how much intervention the children in the implicit instruction group received and there was no specific description as to what the explicit/metalinguistic instruction consisted of or how it was applied. The current study utilized a standardized treatment protocol for each participant across implicit and explicit conditions and controlled the amount of implicit and explicit instruction provided to the participant to reduce the introduction of confounding variables. Additionally, in contrast to previous studies that evaluated explicit instruction based on visual cues within decontextualized tasks, such as sentence construction and picture identification, (Bolderson et al. 2011, Kulkarni et al. 2014), the current study employed naturalistic techniques appropriate for younger children. This included provision of explicit rules in verbal format within the context of a story and within play activities.

Method

Participants

This study included two children aged 5 and 6 years identified with developmental language delays and characteristics of ASD. To recruit participants, research staff contacted service providers likely to be working with children eligible for the study, including private clinics and schools. Research staff asked the service providers to share study information with families whom they believed would be appropriate for the study. Parents who were interested in the study consented for the research team to have permission to contact them. Informed written consent was obtained prior to the first assessment.

All study participants were required to meet the following criteria: (a) be between the ages of 4 and 7 years; (b) be a native speaker of mainstream English; (c) have parent concern regarding their child's language development; (d) obtain a standard score on the SPELT-3 below 95 or score below screening criterion on the Rice Wexler Test of Early Grammatical Impairment (TEGI; Rice & Wexler, 2001) to ensure language impairment; (e) have mean correct responses on at least 1 form assessed by the TEGI that is less than or equal to 40%; (f) have no history or indication of neurological disorders, such as stroke, traumatic brain injury, seizure disorders, cerebral palsy, or attention deficit disorder as reported by the participants' parents; and (g) pass a standard hearing screening.

Participant 1 (P1) was a white, European-American male who was 6 years, 7 months at the start of the study. He lived at home in a two-parent household. Both parents

were college-educated with one parent holding a Master's degree and one parent holding a Bachelor's degree. The parent endorsed a preliminary diagnosis of mild-moderate range ASD obtained from the family developmental pediatrician. P1 had been receiving speech-language services for approximately 5 years in addition to occupational and physical therapy. During the study he was receiving private speech-language intervention two times per week for 60-minute sessions. Therapy focused on naming members in a category, answering "why" questions, following directions containing comparative location concepts, and retelling 2-3 details about remote events. Treatment targets did not appear closely related to the grammatical target in the current study.

Participant 2 (P2) was an Asian/Pacific Islander male who was 5 years, 2 months at the start of the study. The only language spoken in the home and by the child was English. P2 lived at home in a two-parent household. Both parents obtained graduate degrees and held professional employment. One parent worked full-time while the other worked less than 30 hours per work. The parent reported no history of seizure, behavior disorder, ADHD, or other developmental or acquired disorder. Although P2 had no formal diagnosis, clinically, he displayed symptoms characteristic of ASD and was receiving speech-language services to address areas of social communication at a private clinic. P2 had been receiving speech-language services for approximately 6 months, 1 time per week for 90 minutes. The focus of speech-language treatment was to increase the use of question forms to make basic requests such as "Can I have…." and "Can you help me…", increase ability to follow 2-step directions, increase vocal intensity, and increase ability to independently initiate interaction with a peer and engage in joint play.

Treatment targets did not appear closely related to the grammatical target in the current study. Table 1 includes a summary of each participant's developmental profile.

Table 1. Participant Characteristics

Assessment	P1	P2
Rice Wexler TEGI		
Third Person Singular	71%; Below Criterion	50%; Below Criterion
Past Tense	100%; Above Criterion	69%; Above Criterion
Do	0%; Below Criterion	80%; Below Criterion
Be	100%; Above Criterion	76%; Above Criterion
SPELT-3		
Standard Score[a]:	86	102
TACL-3 Standard Scores		
TACL Quotient[a]	89	94
Vocabulary[b]	6	8
Grammatical Morphemes[b]	9	8
Elaborated Sentences[b]	10	11
Language Sample		
Total # Utterances	270	324
MLU	4.79	3.64
Conners' Parent Rating Scale-Revised-Long Form T-Scores[c]		
Oppositional	47	44
Inattention	68	56
Hyperactivity	68	39
Social Problems	78	70
ADHD Index	74	54
Emotional Labiality	56	39
Connors' Global Index	72	44
Leiter International Performance Scale – Revised*		
IQ Composite Standard Score[d]:	67	70

[a]Mean of 100 and standard deviation of 15. [b]Mean of 10 and standard deviation of 3. [c]Mean of 50 and standard deviation of 10. [d]Mean of 100 and standard deviation of 15.
*Examiners adhered to standardized administration. All instructions were given in nonverbal format.

Assessments

The following assessments were used to confirm study eligibility and to characterize participants' language development, cognitive level, and behavioral profile: (a) Rice Wexler Test of Early Grammatical Impairment (TEGI; Rice & Wexler, 2001); (b) Structured Photographic Expressive Language Test 3 (SPELT-3; Dawson, Stout, & Eyer, 2003); (c) Test for Auditory Comprehension of Language 3 (TACL-3; Carrow-Woolfolk, 1999); (d) conversational language sample; (e) Conners' Parent Rating Scale-Revised-Long Form (CPRS-R:L; Conners, 1997)); (g) Leiter International Performance Scale – Revised; (Leiter-R; Roid & Miller, 1997) (h) hearing screening; (i) developmental and current service questionnaires.

Rice Wexler Test of Early Grammatical Impairment (TEGI; Rice & Wexler, 2001). The TEGI is a criterion-referenced standardized test designed to evaluate grammatical deficits in children between the ages of 3 and 9 years. Participants completed the three core TEGI probes, including the Third Person Singular Probe, the Past Tense Probe, and the Be/Do Probe. The TEGI has an average .91 sensitivity (range = .86-.94) and .82 specificity (range = .80-.84) at the specified screening criteria levels. Criteria levels or "cut points" represent performance levels that separate the normal group from the language disorder group. The TEGI was used to help determine study eligibility and to identify treatment targets.

Structured Photographic Expressive Language Test 3 (SPELT-3; Dawson, Stout, & Eyer, 2003). The SPELT-3 includes 54 full color photographs of everyday situations and objects paired with simple verbal questions and statements to elicit specific

morphological and syntactic structures. The SPELT-3 has .90 sensitivity and 1.0 specificity with a 95 cutoff for 4-5 year old children with language impairment (Perona, Plante, & Vance, 2005) across the 5 to 7 year age range. The SPELT-3 yields a standard score with a mean of 100 and a standard deviation of 15. The SPELT-3 was also used to help determine study eligibility and to help identify treatment targets.

Test for Auditory Comprehension of Language 3 (TACL-3; Carrow-Woolfolk, 1999). The TACL-3 consists of 142 items divided into three subtests that assess a child's ability to understand English vocabulary, grammatical forms, and elaborated phrases and sentences following categories. It is appropriate for children 3 through 9 years. The assessment yields a TACL-Quotient score with a mean of 100 and a standard deviation of 15 as well as standard scores for each subtest with a mean of 10 and standard deviation of 3.The TACL-3 was used to characterize receptive language comprehension ability.

Language sample. A research assistant obtained a conversational language sample from each participant that was approximately 30 minutes in length. The language sample was elicited during play and reading activities as well as via direct prompting (e.g. Tell me about what you did at school today?) The language samples were transcribed and analyzed to assess expressive language ability specifically mean length utterance (MLU) in morphemes. MLU was calculated by dividing the total number of morphemes by the total number of utterances. MLU is one indicator of morphological and syntactic development.

Conners' Parent Rating Scale-Revised-Long Form (CPRS-R:L; Conners, 1997). The CPRS-R:L is a widely used parent report instrument that assesses symptoms of ADHD and other problem behaviors in children between the ages of 3 and 17 years. The Connor's yields standard scores for each subscale related to inattentive symptoms and hyperactive-impulsive symptoms with a mean of 50 and a standard deviation of 10. A standard score greater than 65 is usually understood to indicate a clinically significant problem. The Connors' was used to help characterize participants' attention abilities and establish a behavioral profile.

Leiter International Performance Scale – Revised (Leiter; Roid & Miller, 1997). The Leiter is a nonverbal IQ test that is not significantly influenced by the child's educational, social, and family experience. It is appropriate for individuals 2 to 21 years of age. The test specifically measures visualization and spatial reasoning. Instructions for all test items are given using nonverbal cues (e.g., pointing, thumbs up, thumbs down). A Brief IQ composite score was obtained with a mean of 100 and a standard deviation of 15 based on 4 subtests. This test was used to describe nonverbal cognitive ability.

Hearing screening. The hearing screening procedures followed the guidelines suggested by the American Speech-Language-Hearing Assessment Panel (1997). To pass the screening, participants had to detect 500, 1000, 2000, and 4000 Hz pure tones presented at 25 dB HL in each ear.

Questionnaires. Parents responded to approximately 33 questions regarding age, ethnicity, parents' education and employment, child's developmental milestones, and special services that the child was receiving. Additionally, with parental consent,

researchers contacted the child's speech-language pathologist. The speech-language pathologist responded to approximately 10 questions regarding the speech-language services that the participant was currently receiving such as current goals and treatment dosage.

Grammatical Target

Upon meeting inclusionary criteria, the research team identified a grammatical target form by reviewing performance on the SPELT-3 and TEGI. For both participants, researchers identified target forms after reviewing performance on the TEGI. P1 produced singular and plural "DO" questions with 25% accuracy. P2 produced singular and plural "BE" copula questions with 20% accuracy.

Experimental Design

The study used a single-subject, multiple baseline, A-B-C design including baseline, implicit treatment, and explicit treatment conditions. The independent variable was the type of treatment, implicit or explicit. The dependent variable was the proportion of accurate productions (spontaneous or elicited) of the target form.

Sessions were typically scheduled two times per week depending on the family's availability. Each participant completed three to five, 25-30 minute baseline sessions during which researchers ensured that accuracy of the target form remained below 30% prior to the start of treatment. Following baseline sessions, participants completed a minimum of five, 25-30 minute implicit treatment sessions. If accuracy remained relatively stable during implicit treatment, participants then moved to explicit treatment for a minimum of five, 25-30 minute sessions. Explicit treatment was discontinued after

the participant demonstrated 80% accuracy or higher across three consecutive sessions (mastery criterion). Immediately after treatment, participants completed three short-term maintenance sessions in which baseline conditions were resumed. If accuracy remained greater than 80%, participants completed three long-term maintenance sessions at 1 week, 1-month, and 2-months post treatment.

Procedures

Trained interventionists conducted all sessions. One was a second year graduate student in speech-language pathology; the other was an ASHA certified (CCC-SLP) Ph.D. student. The same general procedures were used for baseline, implicit, explicit, and maintenance sessions. Across all conditions, each session included a focused stimulation activity followed by an instructional play activity. For the focused stimulation activity, the interventionist read aloud a story that included 8-12 models of the target form. This was followed by a play activity in which the interventionist created opportunities for the participant to produce the target form using characters and themes from the story.

Focused stimulation model story activity. Research assistants who were undergraduate students in the Department of Speech-Language-Hearing Sciences created 17 thematic stories that contained 12 models of the target form. In each story, each model was applied to a unique verb from the MacArthur-Bates Communicative Development Inventory (MB-CDI; Fenson, Marchman, Thal, Dale, Reznick, & Bates, 2007). This was done because evidence exists that children acquire forms faster when applied to a variety of verbs (Plante et al., 2014). For P1, each story included 6-8 models of the target plural "do" questions, and 4-6 models of the contrastive singular "do" questions. Researchers

chose to provide models of the singular form as a contrast to the plural form to facilitate learning; however, it was not the target of intervention which is why fewer models were included in the story. For P2, each story included 6 models of singular copula "be" questions and 6 models of plural copula "be" questions.

Researchers purchased toys related to each story theme. See Table 2. for a sample list of themes and Appendix A for a sample story. Each story was approximately 150-200 words in length with an MLU of 8.00 – 10.00. During the story activity, the interventionist worked to maintain the child's attention by acting out the story with appropriate toys, using exaggerated voice/action, modifying the environment to reduce distractions, and directly requesting the participant's attention (e.g., "Listen to me").

Table 2. Focused Stimulation Model Story Themes

	Story Theme	Toys
1.	Soccer	Soccer figurines, table size play field, miniature soccer ball.
2.	Medical	Play medical kit: stethoscope, otoscope, Band-Aid, syringe.
3.	Pirates	Ship, treasure chest, and pirate figurines
4.	Park	Skateboard park miniature and figurines
5.	Halloween	Haunted house, vampire and Frankenstein, rats, electric chair.

Instructional play activity. After the focused stimulation activity, the interventionist gave the participant the opportunity to play with the same toys used by the interventionist in the story. The goal of the activity was to provide the child with 12-20

opportunities to use the target form. These were spontaneous attempts by the child or prompted opportunities in which the interventionist elicited the target form with a directive (e.g., “Ask if the garage door closes”). This was the only activity that was altered across the three conditions.

During baseline and maintenance sessions, the interventionist read aloud a model story and facilitated a structured play activity as described above. In contrast to the treatment sessions, the clinician did not provide any recasts or explicit instruction during the play activity.

In the implicit treatment sessions, if the child made an erroneous attempt of the target form during the play activity, the interventionist provided a recast that emphasized, with vocal stress, use of the correct target form in a complete sentence. The child was not directly told if his production was correct or incorrect and the interventionist did not explicitly point out the child’s error.

In the explicit treatment sessions, if the child made an erroneous attempt of the target form, the interventionist provided explicit feedback in addition to a recast during the play activity. Explicit feedback consisted of verbal instruction such as directly referencing the child’s error (e.g., “Uh oh, you started with “does”) and explaining the grammatical rule guiding the target form (i.e., “When we ask a question about more than one person or thing, we say “do” instead of “does”).

Data Analysis

The interventionists audio recorded all baseline, treatment, and maintenance sessions using a portable digital recorder with an internal microphone (Marantz

PMD620). Interventionists calculated accuracy scores for all sessions. Visual inspection of the data was used to examine acquisition differences associated with the independent variable. The participants' accuracy in producing the target grammatical form was visually analyzed in terms of level, trend, and variability across baseline, treatment, and maintenance phases.

Additional statistical analysis included calculation of effect size using percent of nonoverlapping data (PND; Scruggs & Mastropieri, 2001; Scruggs & Casto, 1987), a measure commonly used to describe treatment effectiveness in single subject design studies. The PND method identifies the highest data point in baseline and then calculates the percentage of intervention phase data points that exceed it (Scruggs & Casto, 1987). We interpreted PND calculations using the following guidelines suggested by Scruggs and colleagues: scores above 90% represent very effective treatment, scores from 70-90% represent effective treatment, scores from 50% to 70% represent questionable treatment, and scores below 50% are ineffective.

Results

Participant 1 (P1)

P1's treatment target was plural and singular "do" questions (e.g., "Does the boy play?" "Do the birds fly?"). P1 completed three baseline sessions over a 2-week period during which his accuracy on singular "do" questions significantly increased from 0% (on the TEGI) to a mean of 95%. However, accuracy on plural "do" questions remained stable at 0%. At the completion of the baseline sessions, researchers decided to proceed

with treatment targeting only plural "do" questions, but continued to probe singular questions 4 to 6 times during a treatment session as a contrast form.

P1 completed five implicit treatment sessions over a 2-week period. During this phase, he achieved a mean accuracy of 5.6%. During the 2nd implicit treatment session he increased to 20% (3/15) accuracy; however, in the 3rd and 4th sessions performance levels returned to 0% (0/13; 0/15; 1/13). Minimal increase was seen in the 5th implicit session with performance at 8% (1/13). Thus, visual inspection (see Figure 1) revealed relatively stable performance and no obvious positive trend in data during the implicit phase. Because gains were relatively minimal and remained below mastery (i.e., 80% accuracy) across these five sessions, we proceeded to explicit treatment.

P1 completed six explicit sessions over a 1-month period. During the first three explicit sessions, P1's performance on the target form was 64% (9/14), 72% (13/18), and 79% (11/14), respectively. Visual inspection revealed an immediate rise in level and an upward trend across these sessions (see Figure 1). Because P1's performance continued to rise across three consecutive sessions, researchers determined it was appropriate to begin fading the frequency of explicit feedback. During the next three explicit sessions, feedback only was provided after erroneous attempts, but at least three times intermittently throughout the session. During the 4th, 5th, and 6th explicit session, respectively, his performance on the target form was 100% (13 /13), 77% (10/13), and 83% (10/12. He achieved a mean accuracy of 87%. Because P1 performed near or above 80% accuracy across three consecutive sessions, researchers withdrew treatment to assess maintenance.

P1 participated in three short-term maintenance sessions over a 1-week period in which baseline conditions were resumed. P1 performed at 100% (12/12), 85% (11/13), 93% (13/14) accuracy across these sessions with a mean accuracy of 93%. Visual inspection of Figure 1 displays relatively stable performance that remained above 80% accuracy for all short-term maintenance sessions. P1 also participated in three sessions to assess long-term maintenance of the target form at 1-week, 1-month, and 2-months post treatment. He performed at 100% (12/12), 92% (12/13), 100% (13/13), respectively, with a mean accuracy of 97%.

For P1, PND between baseline and implicit phases was 40% indicating minimal change in performance or ineffective treatment. PND between the implicit and explicit phases was 100% indicating a significant change in performance. See Table 4 for summary of PND effect sizes for each participant.

Figure 1. Results for Each Participant

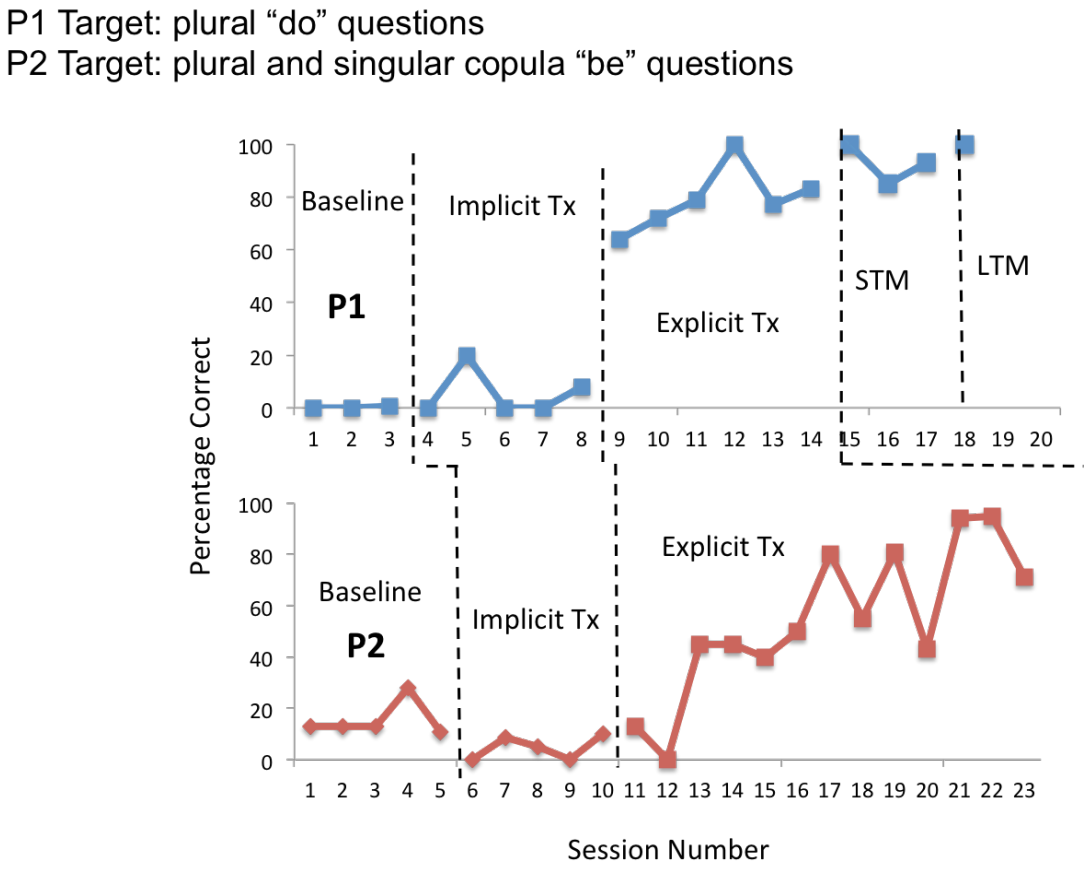

Table 4.
Percent of Non-Overlapping Data (PND) for P1 and P2

Phase Contrast	**P1**	**P2**
Baseline vs. Implicit	40%	0%
Implicit vs. Explicit	**100%**	**93%**

Effect sizes suggestive of clinically significant change (i.e., PND value greater than 50%) are bolded.

Participant 2 (P2)

P2's intervention target was plural and singular copula "be" questions (e.g., "Are the men hungry?" "Is the man gone?"). P2 completed five baseline sessions over a 1-month period. His baseline performance of 13% (2/15), 12.5% (2/16), 13% (2/15), 28% (5/18), 11% (2/18) remained relatively stable and yielded a mean accuracy of 16%. During the fourth baseline session, his performance increased slightly to 28% accuracy, but dropped back to 11% accuracy during the fifth session. Due to his low and relatively stable performance across the five baseline sessions, researchers proceeded to the implicit treatment phase.

P2 completed five implicit treatment sessions over the course of approximately three weeks. His accuracy across these five sessions in order was: 0%, (0/18), 8.7% (2/23), 5% (1/20), 0% (0/21), and 10% (2/20). His mean performance accuracy across the implicit treatment sessions was 5%, which was lower than the baseline mean. Visual inspection revealed relatively stable performance levels with no positive change in level or upward trend in data. Thus, after the fifth implicit session, the explicit treatment phase commenced.

At the time of this report, P2 had completed 13 explicit treatment sessions over a 7-week period. His accuracy during the first three explicit sessions was 13% (3/23), 0% (0/9), and 45% (9/20), respectively. Visual inspection of these data revealed a substantial increase in level beginning at the 3rd explicit session. This rise in performance remained stable at 40-45% across the next two consecutive sessions. Further data analyses revealed that he was at 90% (9/10), 78% (7/9), and 70% (7/10) accuracy for the singular form (i.e.,

"is" questions), but at 0% (0/10), 18% (2/11), 10% (1/10) accuracy for the plural form for 3rd, 4th, and 5th session, respectively. Qualitatively, the interventionists noted that P2 correctly implemented the rule by starting plural copula questions with "are" and singular copula questions with "is," however accuracy remained low for plural questions because he produced "are" two times in the question (e.g. "are the monkeys are hungry?").

Due to stabilization below mastery level, the interventionist provided additional explicit instruction starting in the sixth explicit session. Additional instruction included highlighting the child's erroneous production to draw attention to his mistake (e.g. "uh oh, you said, "Are monkeys ARE hungry?") and explicit description of the error with a rule (e.g., "You said 'are' two times; we only say it one time at the beginning"). Following additional explicit instruction, an upward trend in performance, with some variability was observed. He reached 80% (16/20) accuracy in the 7th session then dropped back to 55% (11/20) in the 8th session. Performance levels fluctuated between approximately 80% and 50% across the next five consecutive sessions. Variability in performance may be explained by the participant's level of cooperation during the sessions. Specifically during the 10th explicit session, the interventionist was only able to elicit nine attempts of the target. Variability in performance levels continued until the 11th and 12th sessions in which he achieved 94% (16/17) and 95% (19/20) for both the "is" and "are" forms. In the final session included in this report, performance again dropped to 71% (17/24). Despite variability in performance levels, visual inspection revealed a positive trend in data with implementation of additional explicit instruction.

For P2, PND between baseline and implicit phases was 0% indicating that the implicit treatment had no effect on performance. PND between implicit and explicit phases was 93%, indicating that the explicit treatment was highly effective (See table 4.)

Discussion

Two early school-aged children with characteristics of ASD participated in a single-subject, non-concurrent, multiple baseline study, which aimed to evaluate the effectiveness of incorporating an explicit instructional approach with traditional implicit approaches to teach true grammatical forms. We evaluated performance throughout implicit and explicit treatment conditions and examined short-term and long-term maintenance. We hypothesized that (a) children would acquire the target form at a faster rate with inclusion of an explicit approach versus implicit instruction alone; and (b) children would maintain accuracy of the target form following explicit treatment.

Each participant underwent a series of implicit treatment sessions followed by a series of explicit treatment sessions targeting a weak grammatical form. Accuracy in producing the target form was measured across each treatment condition. Throughout baseline and implicit treatment, performance levels remained relatively stable for both participants with no clear positive trend. Upon switching to explicit treatment, participants demonstrated a substantial increase in accuracy within the first three sessions. A positive trend was observed for both participants during explicit treatment, although P2 demonstrated more variability in performance in comparison to P1. P1 reached mastery criterion (80% accuracy or higher across three consecutive treatment

sessions) after completion of the 6th explicit session. P2 reached mastery criterion for singular ("is") copula questions by the 5th explicit session, although performance for plural ("are") copula questions did not increase until additional explicit instruction was implemented. P2's performance remained above 70% during the final three sessions included in this report, although mastery criterion was not reached. Despite variability seen in P2's performance, results from the study support our hypothesis that incorporating an explicit instructional approach into grammatical intervention leads to faster increase in accurate production. Effect size calculations also support our hypothesis. For both participants, PND in the implicit phase represented ineffective treatment; whereas, PND in the explicit phase represented highly effective treatment.

In order to assess long-term maintenance of the target form, P1 completed three sessions 1-week, 1-month, and 2-months post treatment in which baseline conditions were resumed. Results obtained for P1 supported our hypothesis that children would maintain mastery of the target form following treatment. He demonstrated 85% accuracy or greater during all maintenance sessions. Maintenance sessions for P2 had not yet been conducted at the time of this report.

Study Implications

As discussed in the Introduction, empirical evidence suggests that traditional implicit approaches used to teach grammatical forms to children yield only modest outcomes after long treatment periods (Fey et. al 1993; Gilbert, 1994; Leonard, Camarata, Brown, & Camarata, 2004; Leonard, Camarata, Brown, & Camarata, 2006). Thus, there

remains a need to develop more efficacious and efficient interventions for children with grammatical language impairment.

During the implicit treatment phase of our study, researchers utilized methodology similar to Leonard and colleagues (2004; 2006) including focused stimulation and recasting during structured play. Leonard et al. found that after 96 treatment sessions and 1,152 exposures to the grammatical target (12 recasts per session), only a few of the 31 children met mastery criteria (mean accuracy approximately 50% for both targets). We found that participants did not make gains in performance under implicit instruction conditions; however, once we incorporated the explicit instruction component, there was a spike in performance for both participants. In contrast to Leonard et al. (2004; 2006), P1 achieved mastery and P2 came close to mastery within a relatively short duration of treatment (6 explicit sessions for P1 and 13 session for P2) with the inclusion of an explicit instructional approach. Thus, our findings provide preliminary evidence in support of explicit instruction and warrant further investigation of these approaches as a promising alternative to improve efficacy of intervention.

Our results are consistent with previous research (Finestack et al., 2009; Motsch, 2008) that has found a significant advantage of incorporating an explicit instructional approach to teach grammatical forms to children with SLI. Finestack et al. (2009) showed that more children acquired novel grammatical markers with explicit instruction. Our findings support the next steps in their research in that we observed the same advantage when teaching true grammatical markers to a small sample of children. Moreover, our study helps to reinforce the conclusions reported by Motsch et al. (2008) by remediating

certain limitations in their study. We used a more clearly defined treatment protocol for implicit and explicit treatment phases, and interventionists trained in implicit and explicit procedures carried out both treatments to increase fidelity. By implementing a more rigorously controlled intervention and clearly outlining instructional procedures in both implicit and explicit phases, we have confidence that the independent variable was responsible for the outcomes we observed.

Another advantage of our study is that it begins to extend previous research on explicit grammatical intervention to a population other than SLI, specifically ASD. As described above there is a paucity of studies that examine grammatical intervention for the ASD populations as well as many others (e.g., DS, FXS). Our study contributes to the present, small body of work currently available and provides preliminary evidence in support of explicit instructional approaches to teach grammatical forms to children with symptoms characteristic of ASD.

Study Limitations

There are several limitations to this study in regard to its design. Researchers employed an alternating treatment, A-B-C design to compare acquisition of target forms with implicit or explicit treatment. Although reversal design is the most rigorous of the single-subject designs in terms of establishing a causal inference (Graham, Karmarkar, & Ottenbacher, 2012), it was not practical to implement reversal into our experiment, as we did not expect children to unlearn grammatical targets once acquired. Despite this, researchers were diligent in their methodology and took measures necessary to reduce

risk of confounding variable (e.g., staggered baseline, standardized treatment protocol across participants) to ensure that observed effects were a result of independent variable.

Our study design was further limited by its small sample size. This single-case study only included two participants. According to standards set forth by What Works Clearinghouse (Procedures and Standards Handbook Version 3.0; Appendix E.2), single-case design studies require a minimum of three replications of an event to provide strong evidence of an effect. In the current report, we demonstrate an increase in performance shortly after the implementation of explicit instruction, but for only two participants. Researchers are currently recruiting a third study participant.

Additionally, because the study only included two children with preliminary diagnoses, study results cannot be generalized to the broader ASD population. Group design studies including groups of children with ASD as well as other impairments (e.g., SLI, DS) are needed to better understand populations for whom explicit treatment approaches may be most beneficial. Despite a small sample size, our study demonstrates value in the field as one of only a few studies to evaluate grammatical intervention for children with language impairment other than SLI and one of the first to evaluate use of an explicit approach in grammar intervention for children with ASD. Further research should be conducted in a more rigorous group design with a larger, heterogeneous population of children of different age levels with grammatical impairment (e.g., ASD, SLI, DS) to determine the effectiveness of this type of instruction for various populations.

Another major limitation of this study is the narrow range of grammatical targets treated. We cannot conclude that the same outcomes would be achieved for all possible

grammatical markers and syntactic elements. Although only two unique forms were targeted in this study, the complexity of explicit instruction provided was quite high. Specifically for P2, verbal instruction involved a multi-part rule (i.e. start with "are" when asking about more than one person or thing, start with "is" when asking about one person or thing, and only say "are" one time at the beginning"). Participants' responsiveness to multi-step rules is a good indication that children would be amenable to less complex explicit rules. Both participants received intervention for question forms in which explicit rules were related to agreement vs. tense marking. As errors in tense marking have been identified a core feature of SLI (Bedore & Leonard, 1998; Leonard, Miller, Gerber, 1999; Rice et al., 1998), further research is needed to explore explicit approaches in teaching these targets as well as others.

A final limitation of note is that reported results are based on data collected by the interventionists. Reliability and treatment fidelity data were not available at the time of this report. However, this data will be available in future publications as reliability and fidelity coding is currently underway. All audio recorded sessions were transcribed by trained research assistants, who were undergraduate students studying speech-language pathology, using conventions of Systematic Analysis of Language Transcripts (SALT; Miller & Iglesias, 2012). Transcribers were blinded to the date and conditions of each session to prevent biases. Currently, trained research assistants, who are Ph.D. graduate students with ASHA certification (CCC-SLP), are in the process of reviewing transcripts and coding the participants' responses to calculate accuracy. Coders will double score 20% of transcripts for inter-judge reliability. In addition, coders will code

interventionists' treatment fidelity. Interventionist codes indicate whether an opportunity for the child to produce the target form is provided and if the type of feedback provided aligns with the treatment procedures established for each phase.

Our study investigated the efficacy of incorporating an explicit instructional approach in a highly structured setting and standardized manner. This allowed us to conduct a more rigorously controlled experiment to reduce the risk of confounding variables and allow researchers to compare performance across participants. When receiving explicit intervention the children were aware of the teaching target and became familiar with the routine of asking questions within the context of the structured treatment activity. An important line of inquiry that was not addressed in this study is whether improved accuracy in producing the target generalized to less structured contexts such as spontaneous conversation. Further research should include examination of generalization such as in a conversational language sample in a less structured context during which the child's attention is not directed towards the teaching target.

Conclusions

The purpose of the present study was to compare an implicit intervention approach and an explicit intervention approach to teach true grammatical forms to children with language impairments. The results revealed a significant advantage for the explicit treatment over the implicit treatment such that immediately after introducing an explicit instructional approach a marked increase in level and upward trend was observed as well as an increase in PND compared to baseline and implicit phases for both participants. The current study provides preliminary evidence to support the use of

explicit approaches to teach grammatical forms to children with language impairments, specifically ASD, and motivates further investigation in this area.

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Appendix A

Sample Story

Target: Is/are copula questions
Theme: Food
Toys: Learning Resources New Sprouts My Very Own Play Food

Tyler and Megan wanted to make their mom lunch. (10)

"Is Mom a picky eater?" Megan asked. (9)

"Not really, but she doesn't eat cheese." (8)

"Why, is she allergic to it?" she added. (9)

"Yeah that's why she never makes grilled cheese." (11)

"**Are grilled cheese sandwiches healthy?" (7)**

"They're not the best, but not the worst" (9)

"Are Dad and Ryan hungry too?" Tyler wondered. (9)

"Probably, we should make something for them." (8)

"How about hot dogs?" Megan suggested. (8)

"Good idea, are they easy to cook? (7)

"Yeah you can boil or grill them." (7)

"Let's grill them they're better that way." (9)

They grilled them and poured some milk. (9)

"Is the milk still fresh?" Tyler asked. (8)

"Yeah, it's still good for three more days." (10)

"That hot dog looks burnt, is it done?" (9)

"Yeah they all look cooked to me." Megan thought. (10)

“Are there condiments in the fridge?” they looked. (10)

“There is ketchup and mustard, perfect.” (6)

“Are the hot dog buns soft?” (7)

“Yeah they are, should we add a side too?” (9)

“What about the bananas? Are they ripe yet?” (9)

“Yeah except one is brown, is it okay to eat?” (10)

“Uh probably not, you can throw that one away.” (9)

Their parents and brother walked in the door. (10)

“Woah, thanks for lunch guys!” they said. (9)

“Is it tasty?” Tyler and Megan wondered. (8)

“Yeah you guys will have to start cooking more often.” (12)

The family enjoyed their meal together. (7)